6.11 South Sound

A. Assessment

1. Salmon Use

Chinook

This is part of the Central and South Sound region, which includes six independent populations in the Cedar-Lake Washington, Green, Puyallup, and Nisqually river systems but none from the streams draining directly to this sub-basin.

a) Juvenile

- Juvenile Chinook salmon from non-natal populations, primarily fish from central Puget Sound and the Carr-Nisqually sub-basins, utilize the shorelines and pocket estuaries for feeding and growth, refuge, physiological transition and as a migratory corridor (juvenile salmon functions). See Figure 3-1 for a list of all Chinook populations. This sub-basin provides direct support to meeting the Chinook ESU criteria by supporting rearing of juveniles of many populations from all five geographic regions of origin, but is likely most importantly for populations from the geographic region it lies within, and adjacent geographic regions of origin.

b) Adult

- Sub-adult and adult salmon from neighboring populations utilize habitats within this sub-basin as a passage corridor and grazing area. This sub-basin provides direct support to meeting the Chinook ESU criteria by supporting rearing of sub adults of many populations from all five geographic regions of origin, but is likely most importantly for populations from the geographic region it lies within, and adjacent geographic regions of origin.

Other Listed Species (not comprehensively reviewed or assessed for this sub-basin)

- Chum salmon: None of the eight populations of the Hood Canal/Eastern Strait of Juan de Fuca Summer Chum ESU targeted for recovery emanate from or use this sub-basin. However, summer chum populations within the ESU are documented to exist in this sub-basin in Coulter Creek, Sherwood Creek, Deer Creek, Cranberry Creek, Johns Creek, and Rocky Creek.
- Bull trout (anadromous): Preliminary core populations within the Puget Sound Management Unit of bull trout do not exist in this sub-basin. It is not known if any anadromous bull trout use this sub-basin.

2. Ecological and Landscape Conditions

<u>Food Web, Ecological Conditions</u>

Portions of this sub-basin exhibit poor water quality, and if not addressed or corrected, may continue to negatively affect the ecology of this sub-basin. As in the Central Puget Sound and

Carr-Nisqually sub-basin, toxic contaminants such as PCBs and PBDEs (and others) are polluting the food web of Puget Sound, particularly the central and south sound basins (three sub-basins: central Puget Sound, Carr-Nisqually, south Puget Sound). Natal Chinook salmon populations from the two basins as well as a primary salmon prey (i.e., Pacific herring) appear to be contaminated with toxics (see following sections for more detail). These "resident" salmon (i.e., natal populations) exhibit greater concentrations of toxics when compared to migratory salmon (i.e., non-natal populations) passing through each sub-basin.

The Department of Natural Resources hypothesizes that because of the extreme tidal range of South Sound and the exacting physiological requirements of eelgrass, the species is effectively precluded from growing in this sub-basin naturally. At extreme low tides, eelgrass would be subject to dessication. At extreme high tides, light would not penetrate the water to a sufficient intensity to sustain eelgrass growth. (Tom Mumford, WADNR, personal communication) This hypothesis should receive further testing. What South Sound does have in abundance is mudflats. These habitats can exhibit extreme primary productivity through production of a diatom biofilm that grows on the mudflat surface. This bio-film is receiving considerable attention for its role in overall primary productivity in intertidal systems as well as its role in stabilizing fine sediments.

A comprehensive approach toward restoration of the historical water quantity, nutrients, and water quality baseline pathways and patterns will likely be necessary to protect and restore ecological functions to conditions supporting viable populations in protected sub-basins with limited circulation, such as the Carr-Nisqually, Hood Canal, Padilla sub-basins. Preventing further degradation of D.O. and other water quality factors including avoidance of further stormwater loadings and NPDES discharge loadings will be key. Beyond that, redirection of sewage treatment discharges to upland treatment and reuse/recharge systems will be needed to reduce summer time loadings that are degrading D.O. levels and shifting nearshore community structure. In South Sound the approach may need to address retrofitting of the existing sewage treatment facilities (e.g., LOTT, Shelton, etc.) and alternative approaches to future projects to reduce nutrient and contaminants loadings to the nearshore to improve D.O. and ecological functions supporting salmon. The same applies to existing and future stormwater treatment approaches (Bill Graeber, NOAA-TRT, pers. comm.).

Re-creation of the Deschutes River estuary represents a riverine estuary restoration potential of regional significance. Restoring the Deschutes River estuary represents one of only a few opportunities to recover an increment of the 70% historic loss of this habitat type in a block large enough to be a fully functional river estuary and to restore ecologic processes at the regional scale. In particular, based upon recent studies on pocket estuary utilization it appears the Deschutes River could serve a significant role in increasing the estuarine rearing potential for the Nisqually Chinook population which would serve to fill some of the ESU need for the life history diversity, spatial structure, productivity, and abundance that riverine estuaries can support (Bill Graeber, NOAA-TRT, pers. comm.)

Overall area

- Total area (deep-water plus nearshore) is 57,344 acres (89.6 square miles), the smallest of all 11 sub-basins
- Deep-water portion (marine waters landscape class) comprises 22,848 acres (35.7 square miles), or 40% of the total sub-basin area.

Nearshore area

- Nearshore portion comprises 34,496 acres (53.9 square miles), or 60% of the total sub-basin area.
- Nearshore area within this sub-basin is 8% of the nearshore area of the entire Puget Sound basin.
- Contains 293 miles of shoreline (beaches landscape class).
- The "key" bays (landscape class) identified in this sub-basin is Henderson Inlet, Budd Inlet, Eld Inlet, Totten Inlet, Oakland Bay, North Bay, Rocky Bay, and Vaughn Bay.
- Ninety linear miles (31%) of the shoreline is designated as marine riparian (defined as the estimated area of length overhanging the intertidal zone).
- In this sub-basin, 3% of the shoreline (10 linear miles) has eelgrass (*Zostera marina* and *Z. japonica*); may be patchy or continuous.
- In this sub-basin, floating kelp does not occur. In this sub-basin, 32% of the shoreline (93 linear miles) has non-floating kelp; may be patchy or continuous.

Landscape Conditions

See Figures E-10.1 through 10.3, E11.4 and E-11.5 for a presentation of some of the landscape conditions for this sub-basin

Pocket Estuary Analysis

We identified 62 pocket estuaries in this sub-basin. They are distributed relatively uniformly throughout the sub-basin, with the exception of only a couple in Hammersley Inlet and Oakland Bay, none in southern Budd Inlet, and none in Pickering Passage.

- Freshwater sources were observed in less than half of the pocket estuaries,
- Based on the assumptions listed in Appendix B, all three of the Chinook functions (feeding, osmoregulation and refuge) were estimated were estimated to occur in 20 of the 62 pocket estuaries. Most of the remaining pocket estuaries were estimated to have two of the three Chinook functions,
- Twenty-six pocket estuaries were estimated to be *properly functioning*. Thirteen pocket estuaries were estimated to be *not properly functioning*. The remaining pocket estuaries were recorded as *at risk*.

Drift Cell Analysis

A drift cell characterization for this sub-basin assessed the role of longshore sediment transport processes in controlling the structure of certain features along the shoreline that support salmon.

For example, the broad intertidal and subtidal shelves that provide shallow, vegetated patches and corridors along the shoreline are a depositional feature of soft sediments generally at the depositional portions of drift cells or at the intersection of longshore drift and deltaic processes. The methods of this analysis are presented in Appendix E, Figure E-11.5 and subsequent text. Recommendations for protection and restoration are highlighted in Tables 6-22 and 6-23.

Threats/stressors

Loss and/or simplification of delta and delta wetlands

Natal estuaries for Chinook salmon do not occur in this sub-basin. There are many other smaller estuaries and delta wetlands in this sub-basin, but no information are presented here.

Alteration of flows through major rivers

Large-scale flow alterations are present on the Deschutes River at Capitol Lake. Refer to the Ecological Section above for information. Smaller dams and diversions likely exist but are not identified here.

Modification of shorelines by armoring, overwater structures and loss of riparian vegetation/LWD

The projected population growth in Thurston and Mason counties between 2000-2025 is 62% (129,470 people) and 52% (25,683 people), respectively (PSAT 2004). In this sub-basin, shoreline armoring occurs along 109 miles (37%) of the shoreline. Over 55 miles of shoreline are classified as 100% armored. Over 147 miles are classified as 0% armored. The total number of overwater structures is 2,626, consisting of ramps (83), piers and docks (228), small slips (2,308) and large slips (7). Overwater structure such as ramps, piers and docks generally overlap with the shoreline armoring regions mentioned above, especially Budd Inlet, Eld Inlet, northern Case Inlet and North Bay and portions of Pickering Passage. Within 300 feet of shore railroad grades occur along 9.1 miles, near the western terminus of Oakland Bay in Shelton.

Contamination of nearshore and marine resources

Regions with 15% or greater impervious surface are concentrated in Olympia and Shelton (PSAT 2004). Sediment samples analyzed from 1997-1999 reveal that some of the greatest toxicity was found in the Port of Olympia based on a series of four toxicity tests designed to gauge impacts on biota (PSWQAT 2002a). In addition, the South Puget Sound region was one of four regions with the greatest degree of degraded sediments (PSWQAT 2002a). 8.2% of the area of South Sound exceeds the state's sediment quality standard and 5.5% of the area exceeds the cleanup screening levels.

Water quality concerns are discussed elsewhere in this evaluation. Ten sewage outfalls and an unknown number of stormwater discharge are also observed in this sub-basin.

Numerous past and present activities contribute to the contamination of nearshore and marine resources in this sub-basin and include, but are not limited to, wastewater discharges from industrial and municipal sources; stormwater discharges; and other hazardous substance spills. These are discussed in more detail in Section 4. In this sub-basin, toxic contaminants such as PCBs in the food chain are a concern. This is discussed in more detail in the realized function section, below.

Alteration of biological populations and communities

Pacific herring have been found to be "3 to 11 times more contaminated with PCBs in central and south Puget Sound than the Strait of Georgia" (WDFW, unpublished data). These WDFW results from 2004 are similar to those reported in 1999 and 2000 in PSWQAT (2002a), where body burdens of PCBs were higher in Pacific herring from the central basin (Port Orchard) and southern Puget Sound basin (Squaxin Pass) than Pacific herring from northern Puget Sound and the Strait of Georgia. Finally, the WDFW researchers report that the PCB-contaminated food web of Puget Sound may explain the source of the PCBs identified in southern resident killer whales. See the ecological section, above, for additional information.

There are approximately 6 hatcheries releasing various salmonids into this sub-basin, which may cause alteration of community structure, competition for available prey resources and predation of wild fish. In addition, the Squaxim Island Tribe maintains net pens for rearing coho salmon in Percival Cove, a part of the Budd Inlet/Deschutes estuary system. There are extensive commercial and recreational shellfish aquaculture operations, mostly raising Pacific (Japanese) oyster, Manilla clams and various native species, especially in Henderson Inlet, Eld Inlet, Totten Inlet, Oakland Bay and Hammersly Inlet systems. Significant recreational fishing pressure may have changed the historic community structure of fish species throughout this sub-basin. Specific hatchery reform recommendations for this region have been formulated by the Hatchery Scientific Review Group available at the following websites.
http://www.lltk.org/pdf/HSRG_Recommendations_February_2002.pdf
http://www.lltk.org/pdf/HSRG_Recommendations_March_2003.pdf

Transformation of land cover and hydrologic function of small marine drainages via urbanization

South Sound has more pocket estuaries than any other sub-basin in Puget Sound based on our analysis and only 8 are stressed with urbanization at this time. See Figure E-11.4 for a list of pocket estuaries and noted stressors from visual observation via oblique aerial photos.

Transformation of habitat types and features via colonization by invasive plants

Spartina spp is not found in this sub-basin. Also, 17% of the shoreline (50 miles) contains *Sargassum muticum*, which may be patchy or continuous.

B. Evaluation

In this section we list goals and evaluate the level of realized function for natal and non-natal Chinook, summer chum, and bull trout. From this we then list each of the proposed protection and restoration actions for this sub-basin, and describe the benefits to natal Chinook, non-natal Chinook, and summer chum and bull trout (if any).

Goals for listed salmon and bull trout whose natal streams are in this sub-basin

a) Provide early marine support for independent spawning aggregations occurring in this sub-basin.

Goals for listed salmon and bull trout how natal streams are outside this sub-basin

b) Provide support for all neighboring Puget Sound Chinook salmon populations from the main basin (e.g., Chinook salmon from the central Puget Sound and Carr-Nisqually sub-basins).
c) Provide support for sub-adult and adult Chinook salmon populations who utilize habitats within this sub-basin as a migratory corridor and grazing area,
d) Maintain and/or increase forage fish production as prey for neighboring salmon populations
e) Provide for connectivity of habitats; also, adequate prey resources, marine foraging areas, and migratory corridors for juvenile, sub-adult and adult Chinook and summer chum for populations from within the main basin (e.g., central Puget Sound sub-basin).

Realized function for listed salmon and bull trout

Fry migrant Chinook – Although South Sound has no natal estuary for an independent population of Chinook and little eelgrass due to its naturally large tide range, 60 percent of the area of the sub-basin is in the nearshore and it has a higher density of pocket estuaries than most other sub-basins (Figure E-10.2). The opportunity exists for fry migrants to derive function from the shallow water, low velocity habitats, but is limited mostly to a few regions within five and 10 miles of the Nisqually estuary (e.g., several pocket estuaries along the west shoreline of Anderson Island, southern Key peninsula and Thurston County shoreline southeast of Johnson Point). These pocket estuaries are nested within mostly protected shorelines and are available and utilized by the non-natal fry migrants from the Nisqually population. A majority of these proximate pocket estuaries are estimated to be properly functioning, providing juvenile salmon functions such as feeding and growth, refuge, areas of physiological transition.

Connectivity between habitat types and landscape classes, including intact freshwater "lenses" (or bands) along shorelines, is essential for small-sized fry migrants emerging from the Nisqually estuary in search of pocket estuaries in the south sound sub-basin. Any disruption such as habitat fragmentation or reduction/elimination of freshwater contribution in areas between the estuary and destination pocket estuaries would be detrimental to the non-natal fry migrants. For example, the reduction or loss of freshwater "seeps" along shorelines due to the loss/reduction of groundwater recharge because of stormwater re-routing to the sound via pipes may prevent fry migrants from reaching pocket estuaries. This activity could jeopardize the fry migrant life history type.

Delta fry Chinook – As a matter of proximity, the opportunity exists for delta fry from the Nisqually population to derive function (rearing, osmoregulatory function, migratory corridor and predator avoidance (refuge)) from the protected shoreline habitats of this sub-basin. On average, delta fry are an abundant Chinook salmon life history type in Puget Sound. As with fry migrants, connectivity between habitat types and landscape classes is essential, and shallow water, low velocity regions are very important. Delta fry moving out of the non-natal Nisqually estuary environment (as larger fish) can access pocket estuaries to the northwest (Case Inlet region) as well as several inlets to the west. Just over one-third of the sub-basin's shorelines are armored, but as delta fry grow to larger sizes and migrate throughout this sub-basin more frequently, the fish are exposed to many regions with wastewater discharges, an increasing occurrence of low dissolved oxygen (Budd Inlet, Case Inlet), elevated water temperatures (Budd Inlet) and a concentrated region of chemical pollution (Budd Inlet) (Figure F-3). In addition, "resident" fish from this and other sub-basins (central Puget Sound and Carr-Nisqually Inlet) are experiencing higher toxic contaminant body burden levels versus those salmon migrating through these sub-basins from elsewhere (WDFW, unpublished data). Finally, the current level of shoreline development places the unique character of this sub-basin and associated functions for salmon at risk.

Parr migrant Chinook – Many of the Puget Sound Chinook salmon migrate to the ocean as sub-yearlings (Myers et. al., 1998), and on average this life history type is the most abundant in Puget Sound. The opportunity exists for parr migrants from the non-natal Nisqually population to utilize shoreline habitats within this sub-basin, and connectivity between habitat types and landscape classes is essential to this life history type. Parr migrants moving northwest out of the Carr-Nisqually sub-basin are thought to greatly utilize, and depend on many of the shoreline habitats within the South Sound sub-basin. As larger juveniles make their way through the region, they will encounter *properly functioning* pocket estuaries clustered near Squaxin Island and Totten Inlet, and *at risk* and *not properly functioning* pocket estuaries spread throughout the remaining sub-basin (except for most of Budd Inlet where none are identified). Parr migrants will encounter heavily armored shorelines in Budd Inlet, Eld Inlet, Hammersley Inlet and portions of Case Inlet, as well as the other stressors described above. The toxic contaminant situation described above also presents a problem for this life history type. As mentioned above, the current level of shoreline development places the unique character of this sub-basin and associated functions for salmon at risk.

Yearling Chinook – Any reduction in capacity as a result of non-support of the other life history types (i.e., primarily parr migrants) within this sub-basin will negatively affect yearling migrants. Yearlings emigrating from the non-natal Nisqually population, as well as from other populations around Puget Sound, can derive some function (e.g., foraging, refuge, migratory pathway) from the many pocket estuaries and stretches of protected shorelines. Other regions of this sub-basin require attention and some restoration activities (e.g., Budd Inlet). Connectivity between habitat types and landscape classes in South Sound is very important to yearlings from all non-natal populations moving about broadly within Puget Sound. Yearling migrants will be exposed to the same types of stressors and ramifications as described in the other sections above. Of concern are the toxic contaminants polluting the food web in the three southern sub-basins, and the body burden effects on salmon.

Sub-adult and adult Chinook - Larger fish migrating through this sub-basin must contend with water quality issues and toxic contaminants in the food chain. Researchers from WDFW have documented that, in general, Chinook salmon living in or migrating through Puget Sound (specifically in central and south sound) are more contaminated with PCBs than stocks outside of Puget Sound (e.g., Columbia River, WA coast). See Figure 4.7 in Section 4. Residence time in the central and southern Puget Sound basins is suspected as a "primary predictor of PCB concentration in Chinook salmon" and as such, those salmon spending the greatest amount of time in central and south sound exhibit the greatest PCB concentrations (WDFW, unpublished data) (Figure 4-8). Another toxic contaminant of concern in Puget Sound is PBDEs, a common chemical that, like PCBs, are found in greater concentrations in resident Chinook salmon versus migratory Chinook salmon.

Listed summer chum – We hypothesize that none of the eight populations of the Hood Canal/Eastern Strait of Juan de Fuca Summer Chum ESU targeted for recovery use this sub-basin.

Anadromous bull trout – We hypothesize that bull trout do not use this sub-basin.

Table 6-22. Recommended protection actions for South Sound

Protection action	Benefit to Natal Chinook	Benefit to Other (non-natal) Chinook	Benefit to summer chum, bull trout, other fish
Protect against water quality degradation		Sustained growth and migratory functions	Sustained growth and migratory functions for other species
Protect pocket estuaries in the eastern third of the sub-basin to support the Nisqually population (west shoreline of Anderson Island, southern Key peninsula and Thurston County shoreline southeast of Johnson Point).		Sustained feeding, growth, refuge and migratory functions for other populations, especially Nisqually population	Sustained feeding, growth, refuge and migratory functions for other species
Aggressively protect functioning drift cells that support depositional features throughout the sub-basin but in particular along the west shoreline of Key peninsula, Hartstene Island, east shoreline of Budd Inlet, all of Totten and Skookum inlets, Oakland Bay and outer Hammersly Inlet (Shoreline Protection Target Areas 4, 6, 7, 9and 12 in Fig. E-11.5). Designate these shorelines for the highest level of protection within shoreline master programs and critical areas ordinances and pass strong policies limiting increased armoring of these shorelines.		Sustained feeding, growth, refuge and migratory functions	Sustained feeding, growth, refuge and migratory functions for other species
Protect small freshwater tributary		Sustained feeding,	Sustained feeding, growth,

regions, especially those that support mudflat structure through deltaic processes (Upland Sediment Source Protection Targets 1,2,3, 13 and 14 in Fig. E-11.5)		growth, refuge and migratory functions for other populations, especially Nisqually population	refuge and migratory functions for other species
Protect against catastrophic events		Sustained growth and migratory functions	Sustained growth and migratory functions for other species

Table 6-23. Recommended improvement actions for South Sound

Improvement action	Benefit to Natal Chinook	Benefit to Other (non-natal) Chinook	Benefit to summer chum, bull trout, other fish
Add enhanced treatment for stormwater discharging directly to Puget Sound to the same standards as for salmon bearing streams		Improved growth and migratory functions	Improved growth and migratory functions for other species
Consider wastewater reclamation and reuse retrofits for LOTT and Shelton wastewater discharges		Improved growth and migratory functions	Improved growth and migratory functions for other species
Aggressively promote shellfish environmental codes of practice		Improved feeding, refuge and migratory functions	Improved feeding, refuge and migratory functions
Encourage voluntary re-vegetation of cleared residential shorelines throughout the sub-basin		Improved feeding, growth, refuge and migratory functions	Improved feeding, growth, refuge and migratory functions for other species
Restore tidal influence to the historic Deschutes estuary (Capital Lake)		Sustained feeding, growth, refuge and migratory functions for other populations, especially Nisqually population	Sustained feeding, growth, refuge and migratory functions for other species
Restore pocket estuaries in the eastern third of the sub-basin to support the Nisqually population (west shoreline of Anderson Island, southern Key peninsula and Thurston County shoreline southeast of Johnson Point).		Sustained feeding, growth, refuge and migratory functions for other populations, especially Nisqually populations	Sustained feeding, growth, refuge and migratory functions for other species